CHAPTER 8

TERMINALS

8-1. Introduction.

a. This chapter addresses the design of railroad terminal and support facilities which are primarily intended to support unit mobilizations. (Design and planning information for terminals at supply depots or ammunition plants should be obtained from the Construction Branch of the Army Materiel Command).

b. Terminals contain track and facilities for:

(1) Loading and unloading. Tracked and wheeled vehicles, containers, equipment, ammunition, fuel, and general supplies.

(2) Holding. Empty cars waiting to be loaded or loaded cars waiting to be unloaded, or cars which require repair or adjustment of the load or tie-downs.

(3) Switching. Maneuvering cars around the terminal, re-ordering or turning a line of cars, or allowing an engine to get on either side of a cut of cars.

(4) Interchange. Holding loaded or empty cars waiting to be picked up by the connecting commercial carrier, or cars delivered to the installation by the commercial carrier.

(5) Storage. For cars infrequently used or moved.

(6) Fueling and housing engines.

8-2. Siting and General Layout.

a. In the siting and layout of terminals, the designer must consider space requirements, logistics, security, safety, the presence and use of existing facilities, character of the terrain and natural drainage, as well as mission requirements When locating a terminal area, a site must be selected which has the correct size, shape, and orientation so that it provides convenient access for both vehicles and railroad service.

b. Where space is very limited, two or more separate terminals may be considered to provide sufficient capacity. This option may result in better traffic flow and less congestion that might occur at a single site, but might also complicate command control of loading operations and security arrangements.

8-3. Track Design.

a. Design Wheel Loads.

(1) For through running tracks in term areas, use table 2-2, "10 MPH or Less."

(2) For tracks where cars are simply placed and removed (as distinguished from those where general running or back and forth switching movements frequently occur), such as warehouse sidings and spur tracks (dead end tracks), including loading and storage tracks, use table 2-2, "Light led Use".

(3) For run-around tracks, passing sidings, yard tracks, wyes, balloon tracks, or other tracks where switching movements commonly occur, use table 2-2, "10 MPH or Less."

b. Gradients.

(1) Gradients on running tracks through a terminal should not exceed 1.0 percent.

(2) On auxiliary tracks where cars may be temporarily left standing during switching, gradients should generally not exceed 0.3 percent.

(3) Gradients on tracks where cars will be left standing for one or more days, such as loading, yard, and storage tracks, should generally not exceed 0.2 percent, with a maximum allowable of 0.3 percent. It is desirable to have these tracks slope away from the main track (or connecting track). Thus, if hand brakes do not properly hold on cars, they would not roll toward the main track.

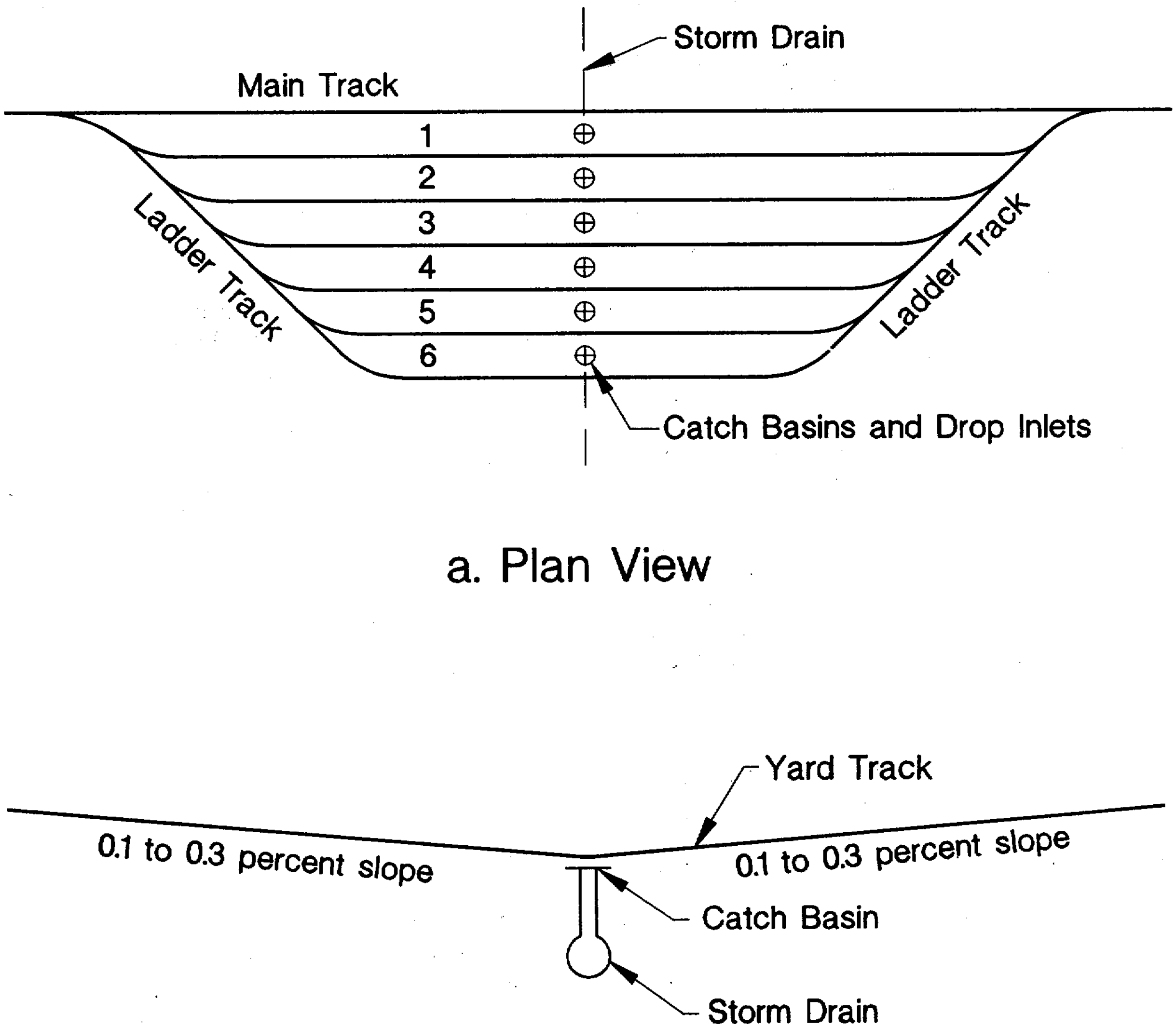
(4) Yards are best graded as shown in figure 8-1, with tracks sloping toward the center, where storm drainage is provided. This grading arrangement will prevent cars from accidentally rolling toward either ladder track and will also facilitate drainage by collecting runoff at the center of the yard.

c. Vertical Curves.

(1) Maximum vertical curvature in a summit should normally be 0.4 percent change in grade in 100 feet, but may be as high as 0.8 percent change entering (or exiting) loading, storage, or other spur (dead end) tracks. Corresponding values for sags are 0.2 and 0.4, respectively. Where track space is available and no interference occurs, use the lower values. The higher values are sometimes needed to avoid putting vertical curvature through a turnout, road crossing, or alongside a loading dock.

(2) It is best to avoid locating turnouts in vertical curves as sometimes problems with point fit or operation result.

d. Horizontal Curves. Track curvature should not exceed 12 degrees in terminal areas. Where nal number 9 or 10 turnouts are the smallest recommended size, curvature elsewhere on the track :ed should not exceed 10 degrees.



b. Elevation

Figure 8-1. Typical Small Yard with Storm Drainage.

e. Track Layout. Design guidance for the layout of turnouts, curves, ladder tracks, and track connections is covered in chapter 7.

8-4. Clearances and Usable Track Length.

a. As terminal track is typically closely spaced near loading docks, buildings, access roads, parking and staging areas, parallel tracks, etc., awareness of clearance requirements is especially important. Clearance requirements are covered in section 7-6.

b. The maximum usable track length for positioning cars extends from the end of track (for spur tracks) to the clearance point, or (for sidings) between two clearance points, as indicated in figure 7-7.

8-5. Vehicle Terminals.

a. Purpose and Facility Requirements. A vehicle loading terminal is generally designed for transferring tracked or wheeled vehicles on or off flatcars, ' or in the case of smaller wheeled vehicles, auto racks (trilevel cars). A vehicle terminal will contain: loading tracks to position on the flatcars; a nearby staging area to hold the vehicles; end ramps or multilevel ramps for transferring the vehicles to and from the railroad cars; a crew and communications facility; and a storage building for blocking and bracing material.

b. Tack Spacing. When the loading tracks in a vehicle terminal are laid out parallel to each other (as is often the case), the tracks should be spaced far enough apart to accommodate one-way vehicle traffic, as shown in figure 8-2.

c. Track Length and Number of 'racks.

(1) For vehicle loading, strings of between 10 and 20 cars are most effectively handled at a time: the lower limit of 10 to minimize switching requirements and the upper limit of 20 for efficient loading. Thus, each loading track should have a tangent length extending from 10 to 20. car lengths from the loading ramp, as shown in figure 8-3.

(2) The number of tracks required can be determined from the traffic and mission information covered in chapter 2, the space available in the terminal area, and the criteria for track length above.

d. Staging Area

(1) The size and location of a staging area depend on terrain characteristics and availability of space. It is recommended that a staging area be located as close to the loading area as possible to facilitate better command and control. The staging area should be large enough to stage one full loading cycle of vehicular cargo, thus a loading terminal with a capacity of 50 flatcars would require a staging area with a capacity of 50 carloads of vehicles.

(2) The staging area must include an access road (or approach) leading up to the loading ramp, which is straight and in line with the ramp for at least the full length of the longest vehicle to be loaded. If practical, this in-line approach should be twice the length of the longest vehicle to ensure that a vehicle can always be positioned ready to load as the first vehicle is driven up the ramp. It is also preferable that this road not be directly adjacent to any tract to avoid a dust cloud from the approaching vehicles reducing the view of loading operations.

(3) For operation after dark, staging areas need to be lighted with "parking lot" type lighting. Fencing may also be required if the cargo is security sensitive. (see para 8-13).

e. End Ramps for Tracked and Larger Wheeled Vehicles.

(1) Rapid loading of larger vehicles onto flatcars is best accomplished with permanent end ramps constructed at the end of the loading tracks. While end ramps may be constructed with concrete, wood, steel or earth, they must be capable of supporting the largest and heaviest vehicles being mobilized (typically, a main battle tank).

(2) A general reinforced concrete ramp design is shown in figure 8-4. More detailed guidance should be obtained from the Army Transportation Systems Center (CEMRD-ED-TT).

(3) A well designed end ramp will:

(a) Allow an M-1 Abrams tank to be driven onto a flatcar having the lowest platform height used in commercial railroad service. (Note: It is safer and easier to drive a vehicle from a lower ramp level to a higher flatcar level than vice-versa).

(b) Provide ample width to enable guides to walk on both sides of an M-1 tank.

(c) Provide sufficient level platform length to allow a tank to be in a completely horizontal position prior to proceeding onto the railcar.

(d) Have the proper transition between the incline and the level platform so that a tank will not "high center" itself while negotiating the ramp.

(4) To make vehicle loading easy, it is desirable to have the end of the car very close to the ramp platform. It is also necessary to protect both the car and the ramp from impact damage when cars are being positioned at the ramp. As car designs vary (draft gear length, amount of end overhand, position of uncoupling lever, etc.), this protection cannot be reliably provided by fastening wheel stops to the track.

(5) The design in figure 8-4 incorporates a cut-out at the front of the ramp at the height of the car coupler. Behind the cut-out is a concrete block separated from the remaining ramp structure with cushioning (expansion joint) material.
This concrete bumper block allows reduces the likelihood of impact damage to the ramp.

(6) Other shock absorbing designs and devices can be used as well, including commercial railcar buffers. The designer should select the method best suited for the particular application. While the concrete bumper block could easily be incorporated into new construction, it might prove impractical during rehabilitation if the existing ramp platform will not be extensively modified.

(7) To permit wheeled vehicles to cross the gap between the ramp and the flatcar, spanner boards may be necessary; tracked vehicles do not require spanner boards. Thus, if fixed spanners are used, they should be detachable so that they will not interfere with the loading and unloading of tracked vehicles.

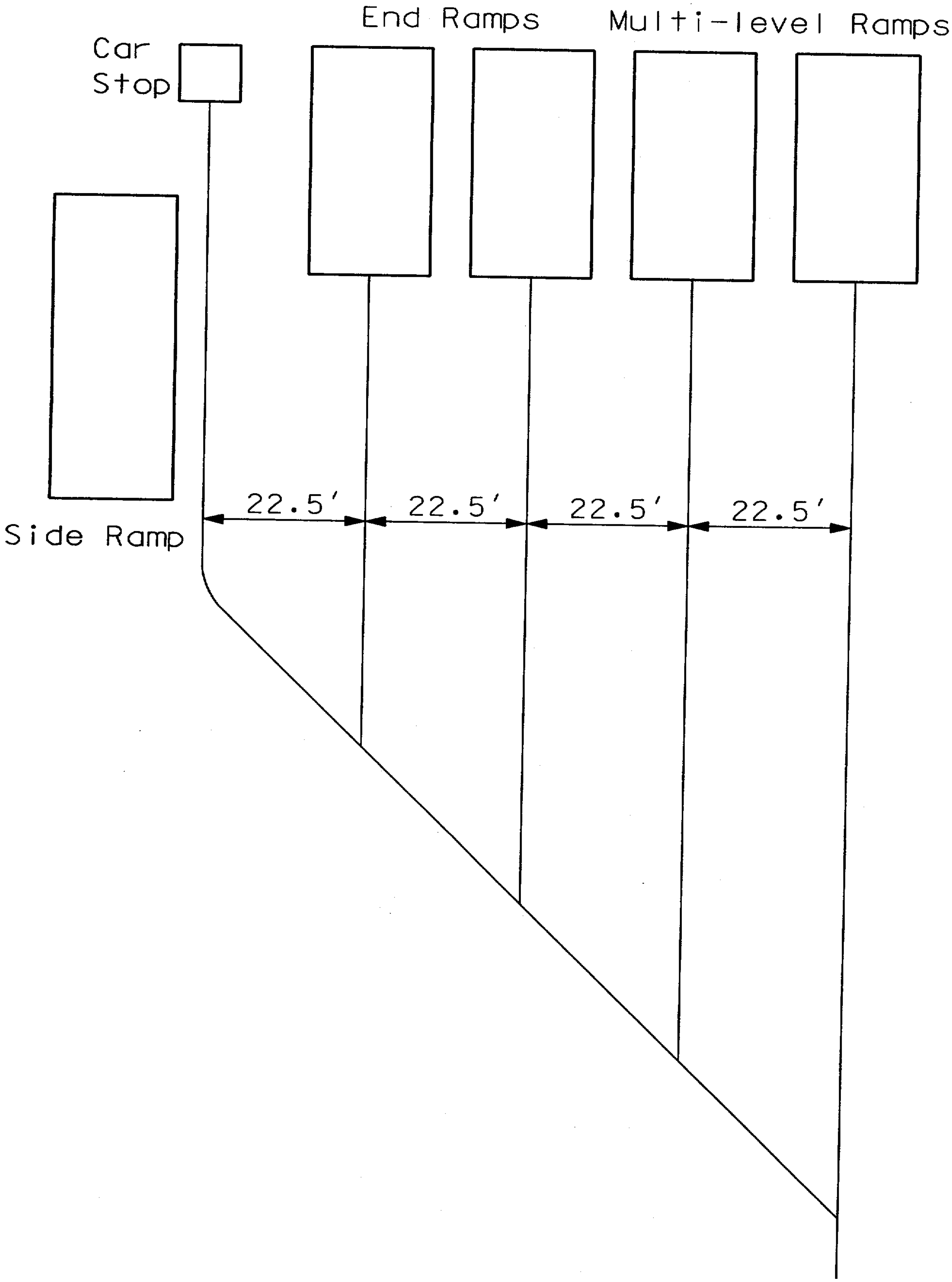


Figure 8-2. Vehicle Terminal.

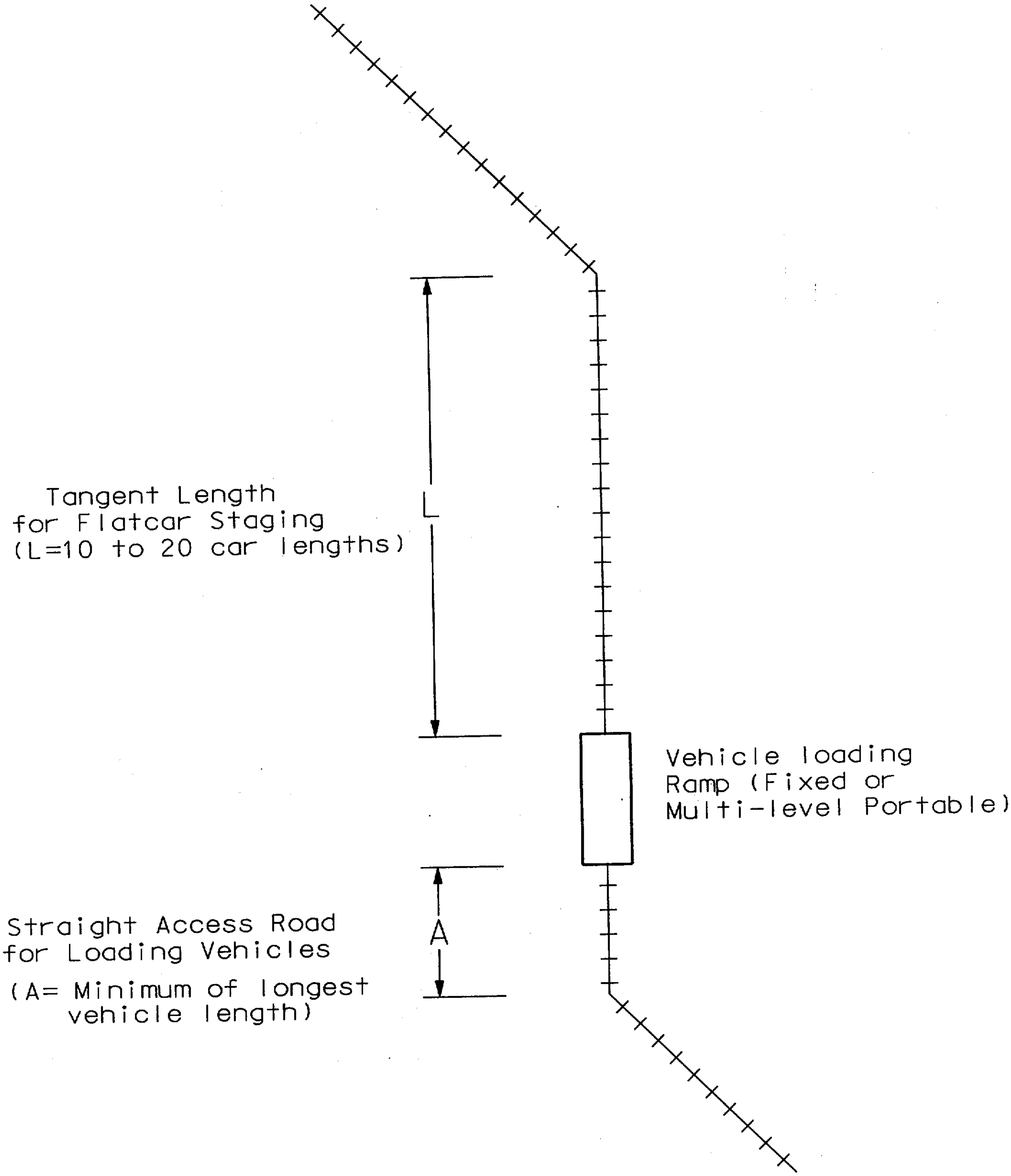


Figure 8-3. Track and Approach Road Lengths for Vehicle Loading.

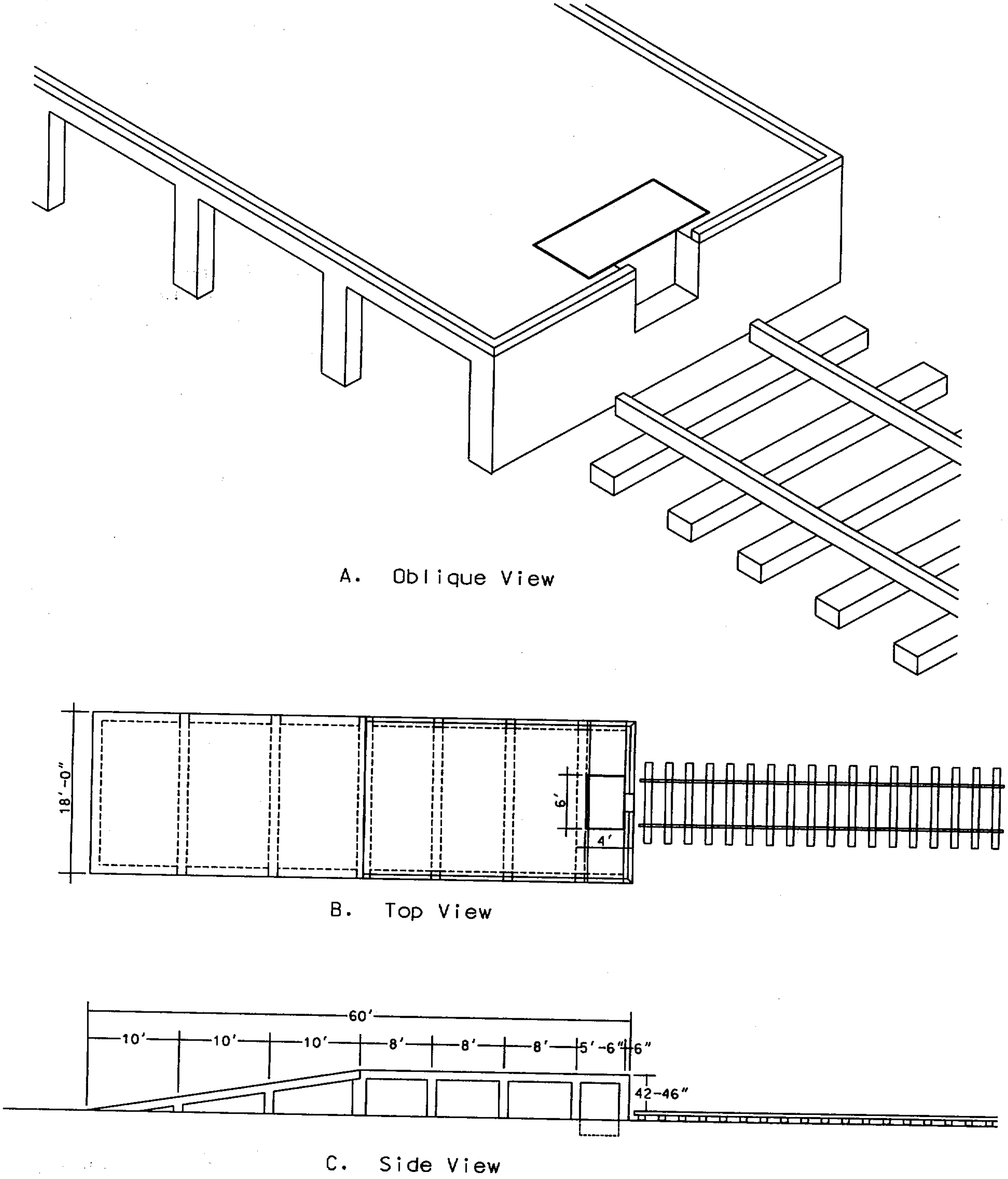


Figure 8-4. Concrete End Ramp.

f. Multilevel Ramps for Smaller Wheeled Vehicles.

(1) If an installation has a requirement to mobilize large quantities of small wheeled vehicles, it is recommended that multilevel ramps be used to load bilevel and trilevel railcars. These ramps are portable pieces of equipment that can either be purchased and maintained by the installation or leased from a commercial railroad when needed. Like end ramps, multilevel ramps are positioned at the end of a track spur. A typical multilevel ramp is shown in figure 8-5.

(2) It is important that the ground underneath a multilevel ramp be level and capable of bearing the weight of the ramp plus the heaviest vehicle being loaded. A portland cement concrete pad is recommended to ensure good ramp stability.

8-6. Break Bulk (Small Cargo) Terminals.

a. Permanent side ramps, parallel to the track are recommended for loading break bulk cargo into boxcars. For staging cargo, large open areas are needed surrounding the ramps. Thus, where, several parallel tracks run through a terminal, the ramps should be constructed along the outermost tracks.

b. Side ramps must meet the following design criteria: (1) The ramp must be capable of supporting the weight of a fully loaded 4,000 pound forklift.

(2) The ramp platform must allow sufficient area for a forklift to maneuver.

(3) The ramp platform must be at a height convenient for a forklift to drive into a boxcar on the adjacent track as well as into a truck docked to at the ramp.

(4) The ramp incline angle must be small enough for a forklift to easily negotiate it.

c. Figure 8-6 shows a diagram of a reinforced concrete side loading ramp.

8-7. Container Terminals.

a. A container loading area includes at least one track spur with sufficient space on one or both sides of the track for a container handler to operate. The required size of a container terminal is related primarily to the largest volume of cargo that must be handled in the shortest time period.
General plans and additional design guidance for container terminals can be found in the AREA manual.

b. A container terminal should met the following design criteria:

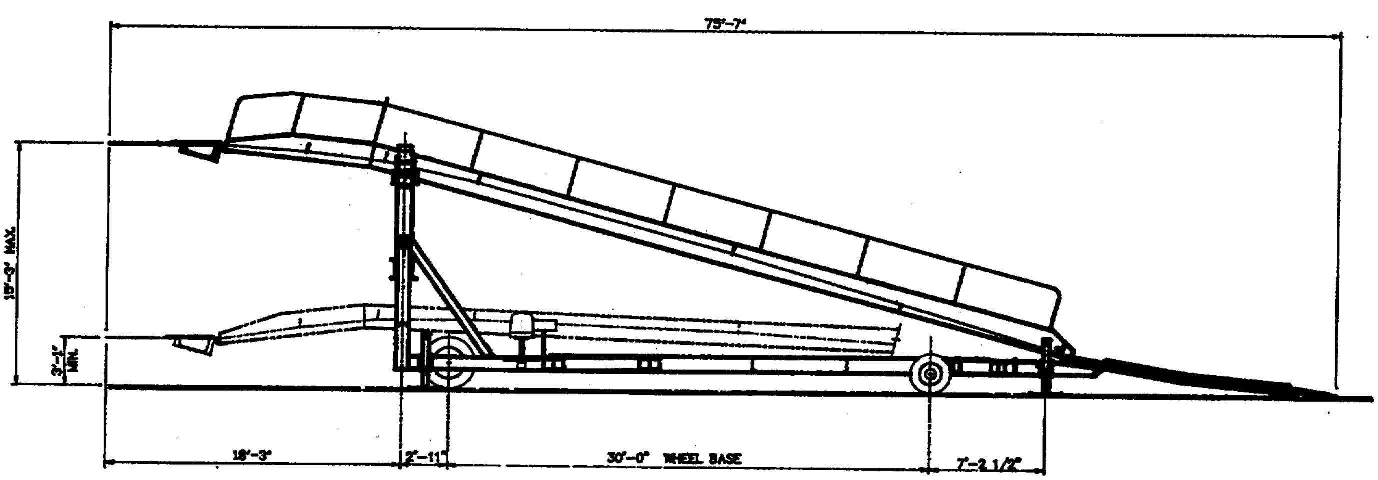
(1) Include at least one straight spur track long enough to hold a minimum of 5 flatcars.

(2) Have one entrance and one exit to the yard area located to establish a one-way circular traffic flow.

(3) Have sufficient open area for a Rough Terrain Container Handler (RTCH) to efficiently operate.

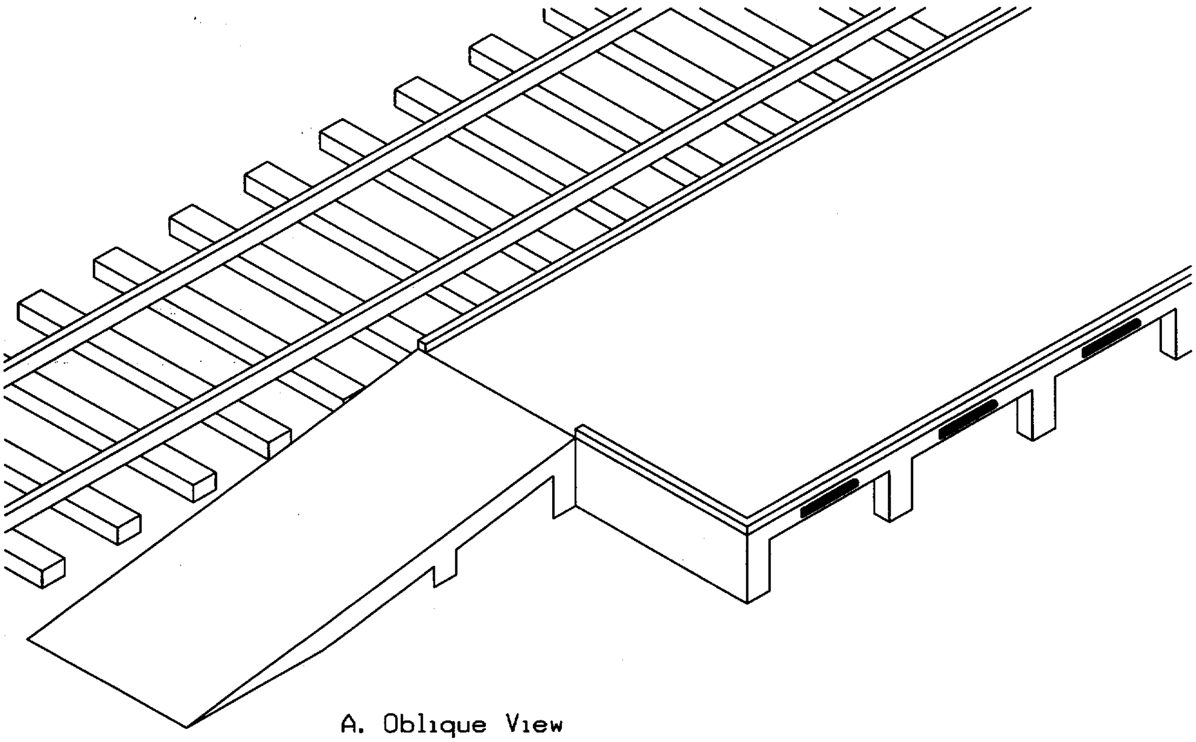
(4) Have a surface which will support the weight of a RTCH carrying a loaded 40' container.

(5) For night operations, have "Parking Lot" type lighting positioned so that the light poles will

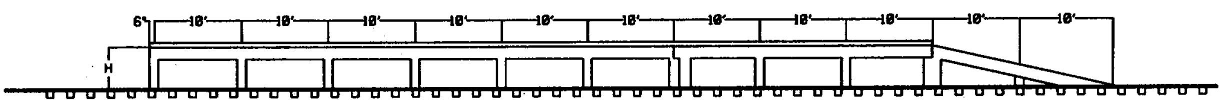


ELEVATION

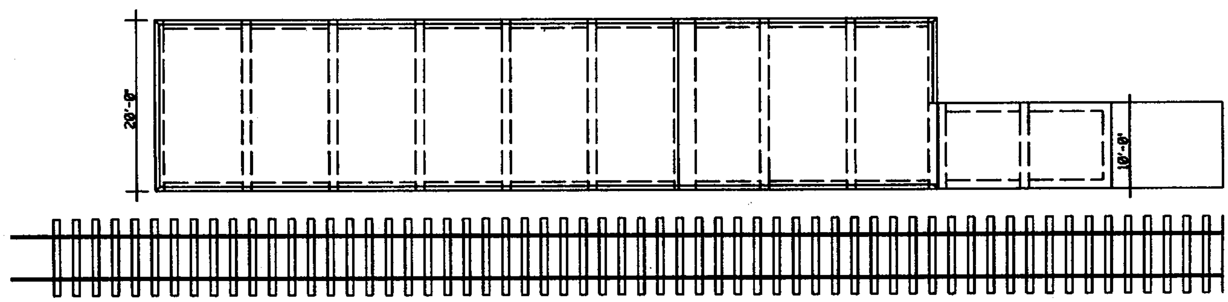
Figure 8-5. Portable Multilevel Ramp.



A. Oblique View



B. Side Elevation (H=height to match car floor)



C. Plan View

Figure 8-6. Concrete Side Ramp. not interfere with the operation of the RTCH or truck-trailers operating inside the yard.

(6) If a secured area is required, have a perimeter fence with a sally port across each track entry and exit. (See para 813).

8-8. Ammunition Terminals.

a. An ammunition terminal should be designed to meet the required shipping volume at the installation. The terminal may be set up as either a break bulk terminal (para 8-6) or a container terminal (para 8-7).

b. In addition to the usual terminal requirements, the following safety standards must by incorporated into the design.

(1) Generally, yards will be laid out on a unit car-group basis with each car-group separated by the applicable above-ground magazine distance.

(2) If the yard is formed by two parallel ladder tracks connected by diagonal spurs, the parallel tracks and the diagonal spurs will be separated by the applicable above-ground magazine distance for the unit-group quantities of high explosive.

(3) If the yard is a tree arrangement, consisting of a center ladder track with diagonal dead-end spurs projecting from each side at alternate intervals, the spurs shall be separated by the applicable above-ground distance for the net quantity of high explosives in the cars on the spurs.

(4) Railroad yards will be separated from other facilities by the applicable Quantity-Distance standards.

c. The following recommendations also apply to ammunition loading areas:

(1) If loaded ammunition cars will stay in a terminal area for sufficient time, the areas should be completely fenced, with sally ports across all tracks entering the area, and have locking pedestrian and vehicular gates. (See para 8-13.)

(2) The area should be lighted with "parking lot" type lighting.

(3) If guard towers are required, they should be positioned to allow observation of the entire ammunition loading area.

8-9. POL Terminals.

a. The design of POL handling and storage areas is regulated by Federal, state, and Iocal environmental protection agencies as well as state and local fire marshalls. These agencies should be contacted when designing POL facilities so that the appropriate standards can be incorporated into the design.

b. POL handling and storage areas should be completely fenced, with sally ports across all tracks entering the area, and having locking pedestrian and vehicular gates. (see para 8-13.) These areas should also be lighted with "parking lot" type lighting.

8-10. Car Interchange.

a. Purpose. The interchange area (or yard) consists of one or more tracks used for the transfer of cars between the installation's railroad and the connecting commercial carrier. These tracks are usually located at or near the junction of the two railroads.

b. Arrangement. An example car interchange yard is shown in figure 87. In this arrangement, one (or both) of the outer two tracks would normally be designated as a running track and left clear of cars. The other tracks would be of sufficient combined length to handle the largest expected number of cars to come in or go out at any one time.

c. Running track.

(1) An open running track through the interchange yard will allow the installation's or commercial railroad's engine access to either end of each interchange track, and otherwise leaves an unblocked connection between the two railroads. The running track can also be used temporarily for switching. This would make it easier to rearrange the cars, if needed, or to pull out selected cars from any track.

(2) At installations with frequent grade crossings or where at least one heavily traveled road crosses the tracks at grade (especially if the crossing angle is less than 45 degrees), access to either end of a cut of cars is usually required. This will permit the engine to always be at the front of a train (pulling the cars rather than pushing), in either direction of travel-providing much better visibility and safety at road crossings.

d. Set-Out Track. It is sometimes useful to allow an additional track (or perhaps a short spur) at an interchange yard for special over-size loads and for cars needing repair-which should be placed only at the end of a train, or for other special movements which need separate handling.

e. Derails.

(1) In addition to being good practice, the connecting carrier will usually require that a derail be placed on the track leading to its line, along with a sufficient safe length of track between the detail and the junction. The derail is intended to prevent cars from accidentally rolling onto (or blocking) the carrier's track. As an option, derails may be desirable at the installation end of the interchange tracks.

(2) While derails themselves are not a design issue, their location is. Without a sufficient length

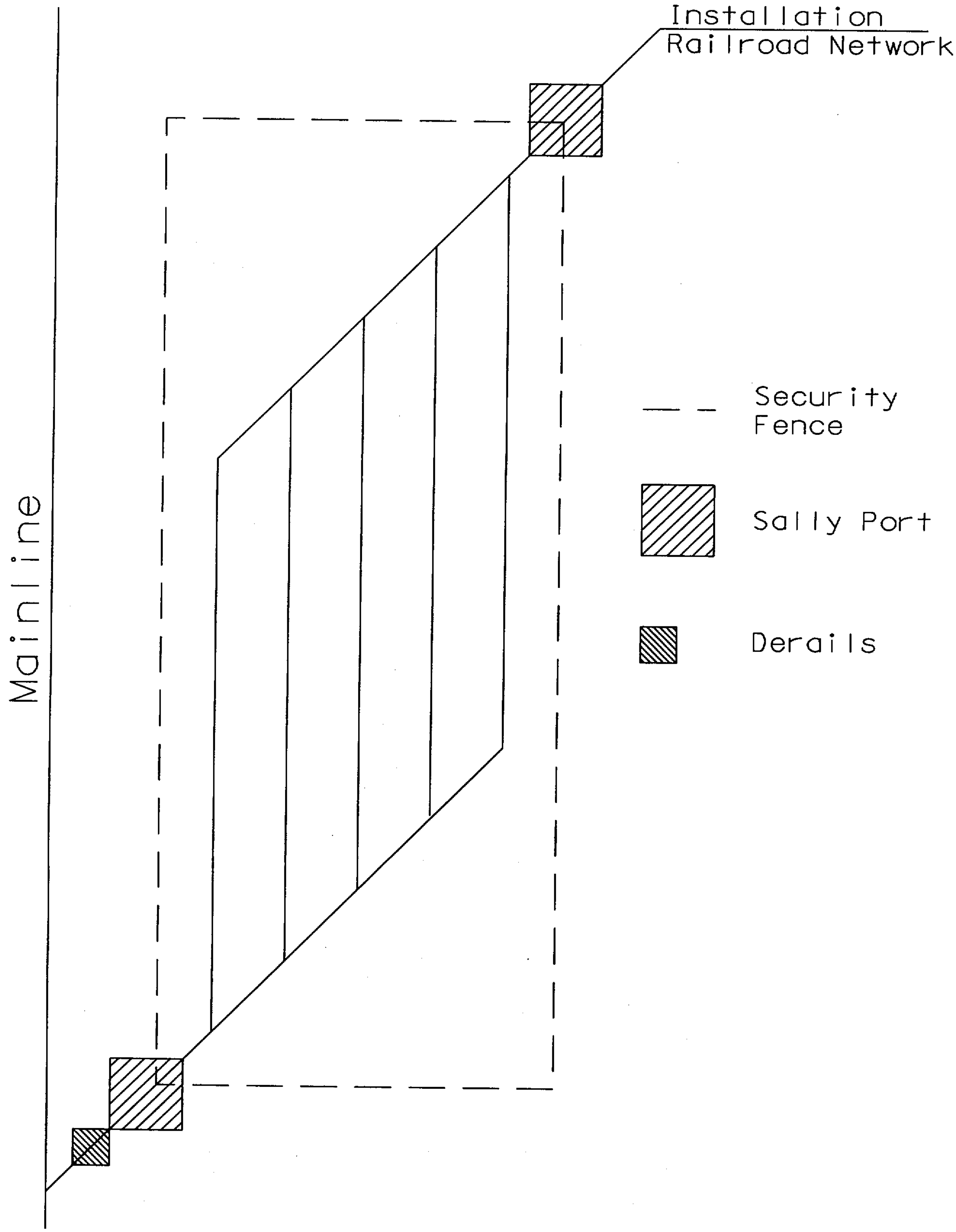


Figure 8-7. Interchange Yard

of track between a derail and the clearance point of the track being protected, a derail will be nearly useless. The designer must allow for this safe track length as an addition to the length of track required for car holding and switching space.

(3) The safe track length needed past a derail will vary with the grade of the yard tracks and the configuration of the junction area. The designer should consult the connecting commercial carrier's engineering department for guidance on placing a derail to protect their track.

f. Security. If the interchange yard is outside the main installation area or otherwise not located within constant view, it is recommended that the area be completely enclosed with a security fence, including lockable sally ports across the tracks. (see para 8-13.) Lighting and guard towers may also be required if security-sensitive cargo is regularly handled.

8-11. Yard, Storage, and Other Auxiliary Tracks.

a Intended Use.

(1) Yard and storage tracks are intended for, respectively, the short and long term holding of cars. Yard capacity is needed at least equal to the maximum number of cars which the installation is expected to handle at one time. Storage capacity must at least accommodate the number of cars to be kept at the installation over a longer term. Loading tracks are not considered available for storage, unless cars are pre-positioned on them for loading.

(2) Auxiliary tracks include sidings, wyes, balloon tracks, crossovers, tail tracks, and other tracks used for switching and maneuvering cars, allowing engines and cars to clear the main track for other movements (as in a second engine switching or delivering cars), or to allow an engine to get around the other side of a string of cars.

b. Yard Tracks.

(1) Especially where the interchange with the commercial carrier is several miles from the loading sites, or where loading sites are within a separate and secure area, a yard may be required. A yard is typically several parallel tracks, as in figure 8-1, which serve as a holding area for cars waiting to be loaded or delivered to the interchange area.

(2) An example is used here of an installation with a mobilization plan calling for 60 loaded cars to be picked up each day (and 60 empties to be delivered) by the commercial carrier, and with loading sites (12 miles from the interchange point) which can accommodate 30 cars at one time. This installation will likely need a yard which will hold at least the second 30 cars waiting to be loaded, and subsequently, the first 30 after they are loaded-to make room for the second 30 at the loading sites.

c. Storage Tracks. Storage tracks or a storage yard may appear as shown in figure 8-1, but are often designed as spur (dead end) tracks off a single ladder, as indicated in figure 7-5. (It is usually not essential to have access to either end of cars in storage, thus saving the cost and maintenance of turnouts at one end of storage tracks.)

d. Auxiliary 'Racks.

(1) Figure 8-8 shows common auxiliary tracks; their application is explained below.

(2) Sidings are used for temporarily holding extra cars, or holding part of a string of cars while the rest are being switched, or to allow an engine to get around to the other end of a string of cars.

(3) Crossovers can be used as a shortcut between routes or to allow an engine to get around a string of cars. In figure 8-8, the crossover, for example, allows trains from the interchange yard access to the siding without having to go south to the warehouse track and then back north again-thus the crossover allows the siding to be conveniently used from either track. In addition, when handling a string of cars longer than will fit on the siding, the cars may be left south of the crossover on either track, with the engine then using the crossover to get to the other track and then around to the opposite end of the cars.

(4) At least one wye or balloon track is almost always needed at military installations. These tracks allow engines and cars to be turned around. This capability is required for most effective use of vehicle terminals. If cars are delivered to the installation such that the vehicles on them would be facing away (backward) from the loading ramps, the cars need to be turned so the vehicles can be driven in a forward direction off the cars. Of the two types of turning tracks, wyes are most common, as they require far less space than balloon tracks. Balloon tracks are typically used if space allows them to conveniently encircle other facilities, thus not requiring a large land area just for the balloon track. Balloon tracks have the advantages over wyes of requiring only one turnout and a single movement to accomplish the turn. Wyes require a backward movement to complete a turn, as well as throwing more switches. Wyes are often created by installing the third leg where a junction already exists (or is required). In figure 8-8, for example, the wye also allows convenient access to the warehouse track from either north or south directions.

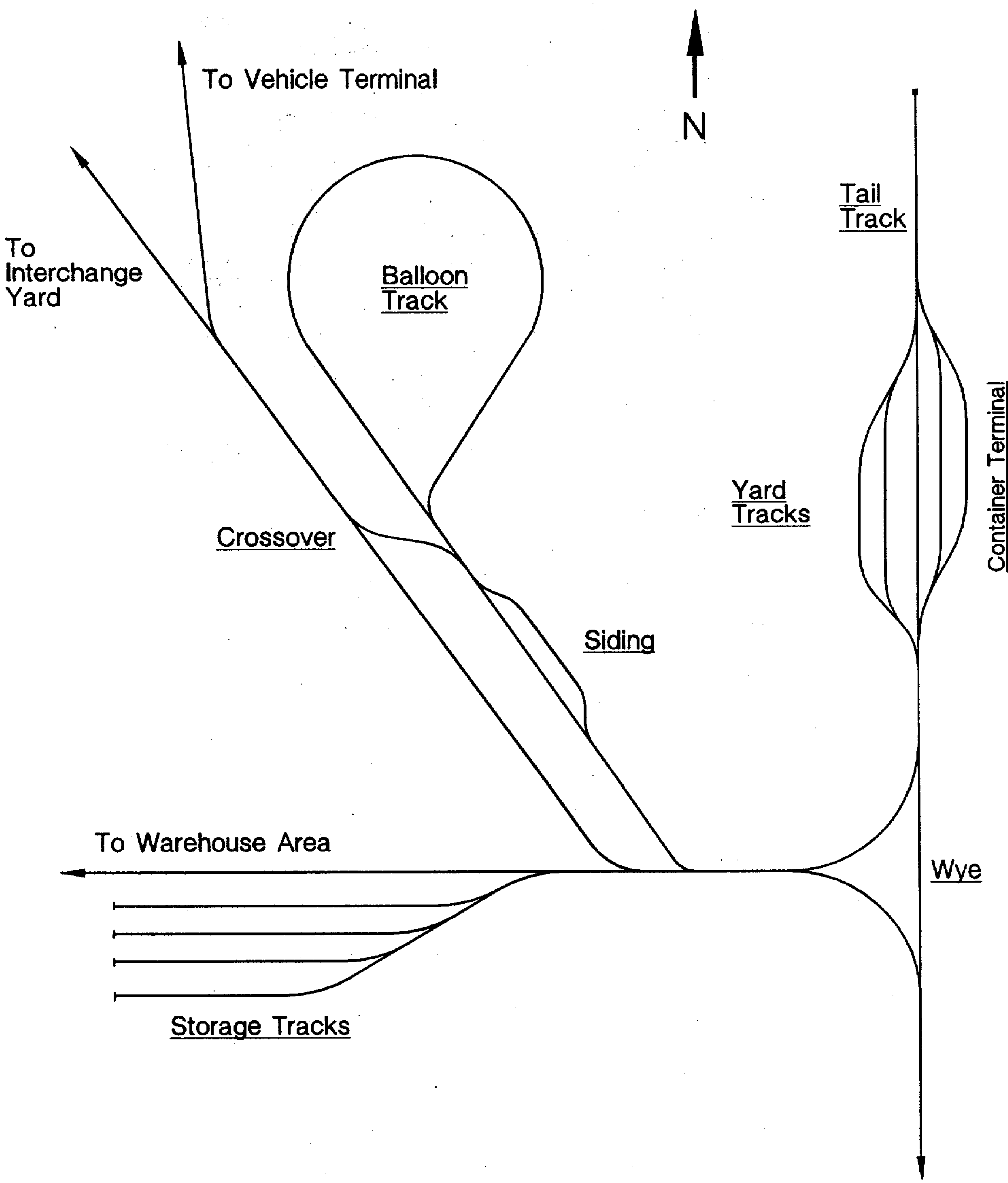


Figure 8-8. Auxiliary Tracks.

(5) When a yard or siding is located near the end of a route, a tail track is often added to allow switching from the far end of the yard or siding. A tail track is most useful if it is at least three car lengths longer than the siding or the longest track in the yard. Figure 8-8 shows a tail track north of the container terminal.

8-12. Miscellaneous Buildings.

a. Purpose. In each terminal area buildings may be needed for storage, shelter, and for other purposes. At vehicle terminals, buildings will be needed for a crew and communications facility and for blocking and bracing storage.

b. Crew and Communications Facility. The following should be considered when designing a crew and communications facility:

(1) The building should be located as close to the loading area as possible without interfering with the flow of vehicles between the staging areas and the loading ramps.

(2) The building should be large enough to accommodate the billeting of a rail loading crew.

(3) A telephone and a public address system would facilitate better command and control.

c. Blocking and Bracing Storage Facility. The following should be considered when designing a blocking and bracing storage facility:

(1) The building should be located as close to the loading tracks as possible. Co-location with the crew and communications facility may be desirable.

(2) The building needs to be large enough to hold the blocking and bracing material required for one cycle of rail loading, that is, enough material for the maximum car capacity of the terminal.

8-13. Security Fencing.

a. Requirement. Security fencing may be required to surround facilities within a terminal, or even a complete terminal area. These fences are typically standard chain-link construction (i.e. 6-foot FE-5), however a more secure fence (FE-6 or FE-7) may be needed. The installation Physical Security Officer should be consulted to ensure that proper security requirements are considered in the design. All gates and sally ports should be equipped with locking hardware.

b. Sally Ports When designing a sally port, the following should be considered: (1) The sally port must prevent unauthorized entry by both pedestrians and vehicles.

(2) The sally port must open to a minimum width of 17 feet to allow cars to pass through.

(3) Culverts draining the track through a sally port should have security bars in them.

(4) It is recommended that a drainage ditch security barrier be constructed using concrete. This will provide both a headwall for the culvert and a foundation to mount rollers for the sliding gate.